

ABT Burner Failures

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Phil Hailes' Comments

Having looked at some of the burners scattered throughout the boiler, I am even more convinced by my initial conclusions as to the causes for the damage. In fact, D5 burner illustrates my point very well. So the following is just my thoughts, based on inspection of the removed burners.

Cracks progress in 3 stages. They proceed sequentially. Stage 1 is first, Stage 2 is second, and Stage 3 is third.

Stage 1: Cracking initiates approximately 6" from the nozzle-to-barrel circumferential joint, on the transition of the barrel circular geometry to the nozzle "flower pedal" geometry. This is the location that the erosive wear of the coal is the most obvious and significant. This always begins on "flower pedal" transition that are on the upper half of the burner. These cracks begin because the material is thinned at this transition point, by erosion, and possibly manufacturing. I submit that the thinned sections crack (after erosion) because of thermal stresses. Once the crack is initiated, they spread longitudinally, along the axis of the barrel, mostly forward, and sometimes rearward.

Stage 2: These cracks are strictly thermal. They progress from the Stage 1 cracks, and run circumferentially around the "flower pedal". They trend along a circumferential line at about the mid-point of the pedals. They initiate from the stress risers of the Stage 1 cracks. These ultimately cause the most obvious damage and are the ones that a casual observer, walking past the burner would notice without getting dirty. When these cracks begin, the party is over. It seems that all or most all of them have originated from a Stage 1 crack.

Stage 3: These are the cracks that initiate from the Stage 2 cracks. They run axially (for-aft) along the flower pedal, parallel to the ridges. They are a result of hoop stresses, caused by the thermal loads, I believe. These also cause more obvious damage, however, they are not as prevalent as Stage 1 and 2, since they appear later in the game, and the stress has likely been relieved significantly by the cracking of Stage 2.

The above conclusions are based on directional crack propagation, sequential A-to-B cracks, and material erosion indications. The first thing to fail is the eroded area of the "flower pedals". They fail first from coal erosion. Once the cracking starts, then the cracks begin to propagate throughout the nozzle.

In summary, it's erosion for a little bit, then thermal takes over and destroys everything. I suppose that if the erosion problems hadn't occurred, perhaps the flower pedal wouldn't have been destroyed. That being said, 70 F to 2700 F is definitely a source of thermal stress, no matter how you cut it.....maybe they would have come apart anyway.